RUSSELL CORROSION CONSULTANTS, INC.
P.O. Box 197 · Simpsonville, MD 21150
(410) 997 - 4481 · Fax (410) 740 - 2541

June 23, 2010

Mr. Nathan C. Atkinson, P.E.
URS Corporation
1800 Washington Blvd.57Suite 410
Baltimore, MD 21230

Subject: **Corrosion Evaluation of Westport Pumping Station Force Main Report of Findings**

Dear Mr. Atkinson:

Russell Corrosion Consultants, Inc. (RCC) is pleased to this Report of Findings for existing Baltimore City force main at the Westport Sewage Pumping Station. This work was conducted on June 9, 2010 at the job site. Burgermeister-Bell Inc. provided excavation services under supervision by URS.

Background and Investigation

The Westport Pump Station Force Main is a 14-inch diameter ductile iron pipe (DIP) measuring approximately 200 feet in length. The force main was installed in the early 1980s, and conveys wastewater from the Westport Sewage Pump Station (SPS) to the South West Diversion (SWD) pressure sewer, which in turn conveys wastewater to the Patapsco Wastewater Treatment Plant. In accordance with Paragraph 9, Item D.i.a of the Consent Decree, a condition assessment of the force main was completed. The Westport SPS is located immediately north of the intersection of Westview Ave. and Cherry Hill Rd., Baltimore, MD (See Figure 1, below).

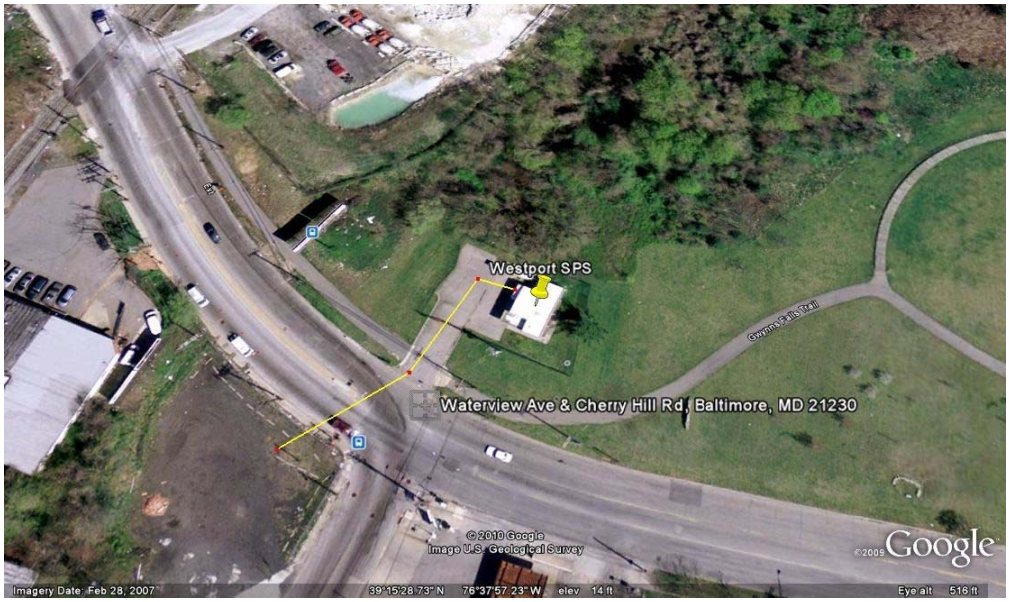

Figure 1 – Site Location w/ DIP Alignment

The force under investigation is approximately 250 feet long and aligned as shown in Figure 1. Due to site characteristics, the area is primarily old fill, near the waterfront and lies within close proximity to the Maryland Transportation Administration (MTA) light rail system. As a result there is concern that the force main and pumping station could be at high risk for external corrosion from both corrosive soils and stray currents.

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In support of this investigation, RCC completed the following tasks:

- Reviewed available drawings, pipe specifications, failure and maintenance history, and any other available, pertinent information regarding the 250 linear feet of ductile iron force main. During this review, more detailed information about the area was discovered based upon an investigation and design conducted by RCC in 2009 for the City of Baltimore (under agreement 1117 for the "Westport Waterfront" water main design plans for the proposed John Moale Blvd.).
- From the data collected for the above reference contract, RCC identified areas along the right-of-way with potential stray current sources including impressed current cathodic protection systems on other utilities and the mass transit system.
- RCC conducted field evaluations that include in-situ soil resistivity measurements and layer analyses to determine soil resistivity at the pipe depth layer. In-situ pH measurements would be obtained at each soil resistivity measurement test location.
- RCC collected soil samples at pipe depth from soil surrounding the pipe for corrosivity analyses in the laboratory. Soil samples were analyzed in the laboratory for levels of resistivity (as-is and saturated), pH, oxygen reduction potential, chloride content, sulfate content, and the presence of sulfides.

URS used Burgermeister-Bell to perform test pit excavations to gather soil samples and allow RCC to examine the external condition of the force main was performed.

The results of this analysis indicate that the external condition of the pipe is relatively sound although there appeared to be minor graphitization on the underside of the pipe. The soil has resistivities which indicate that it is very corrosive and the pH appeared to be low. Based upon preliminary results RCC recommends that the City installs galvanic cathodic protection to the force main.

Results of Investigation

The profile of this force main is a continuing upward grade with >2% inclines and no apparent areas where sewer gases could collect and result in internal corrosion. Specifically, the force main is laid with constant, increasing slope from the wet well until it discharges into the SWD. Therefore, there are no significant localized high points exist which eliminates the risk of gas entrainment that could like to hydrogen sulfide attack. In addition, two blow-offs were installed which allow any trapped gas to escape. Finally, because this main discharges into a pressurized section of the SWD, there is no free outfall condition and no exposure to gases. This alignment coupled with the age of the force main allows RCC to conclude that the risk of internal degradation is low.

RCC conducted soil resistivities at an area within 50 ft and west of the force main, but north of Westview Avenue. This area is noted as Location #1 on the field notes. The soil resistivity was recorded as 7,124 Ohms/cm at 4 ft depth and 5,745 Ohms/cm at 8 ft. depth. South of Westview Avenue in Location #2, the readings taken were 5,745 Ohms/cm at 4 ft depth and 766 Ohms/cm at 8 ft. depth. These data compared favorably to the resistivities of the soils taken from the area surrounding the DIP force main, which were tested and found to be 2,100 Ohm/cm. The result is that these readings indicate that the soils are corrosive and could have a long term negative impact on the DIP and buried pumping station systems if unprotected. Additionally, these data compared favorably to the data collected by RCC (for the John Moale Blvd project) in 2009 where the Barnes Layer Analysis indicated soil resistivities in the 3,000 to 7,000 Ohm/cm range for soils at 8 ft. depth.

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Figure 2 - Close view of DIP Force Main at Excavation

As noted previously, the pipe was exposed and tested using a hammer to test for graphitization of the ductile iron (the primary corrosion mechanism for DIP) and the upper area of the pipe appeared to be sound and generally free of graphitization. The underside of the pipe appeared to have slight graphitization but the extent was undetermined. (See Figure 2, above)

Stray current analyses were completed for the City of Baltimore under the recent contract (2009) for "Westport Waterfront" for the proposed John Moale Blvd. water mains and stray currents were recorded in the general region surrounding the force main.

Results/Recommendations

RCC recommends that the City conduct additional investigations to further identify corrosion rates on the existing DIP force main which will result in the design and installation of a cathodic protection system. The existing force main has minor graphitization occurring but RCC is unable to estimate a remaining life. However, based upon the investigations into the surrounding soils and the John Moales Blvd project, coupled with the fact that the existing DIP does not have a cathodic protection system, RCC believes the DIP is at risk for severe corrosion damage and should be protected as soon as possible. A properly designed and installed cathodic protection system will eliminate the possibility of corrosion causing a force breakage and the resulting sewage overflow spilling into the storm water system nearby.

We appreciate the opportunity to provide these services. Please call us if you have any questions or require additional information.

Sincerely,
RUSSELL CORROSION CONSULTANTS, INC.

John O. Smith, P.E., BCEE
Sr. Engineer

cc: T.R. Fowler
R. Grant

enclosures